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# LGM ice sheets simulated with a complex fully coupled ice sheet – climate model

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One major challenge in predicting future climate change is the validation of the numerical models used for the predictions. A particular good time period for testing ice sheet – climate interactions is the last glacial maximum (LGM). It combines large ice sheets with good proxy data cover. We use a coarse resolution complex climate model coupled with an ice sheet model to study the ice sheets and the climate of the last glacial maximum. We validate our setup by comparing glacial as well as pre-industrial equilibrium experiments with reconstructions and the present state. Since the last glacial maximum climate is largely different from the pre-industrial climate, we can test our model under large perturbations that go beyond the linear range by running both setups.

Our model comprises of the atmosphere-ocean-vegetation general circulation model ECHAM5/MPIOM/LPJ interactively coupled with the ice sheet model mPISM. mPISM is a modified version of the Parallel Ice Sheet Model from the University of Alaska, Fairbanks. We run ECHAM5 in T31 resolution ($\sim 3.75°$), and mPISM on a 20 km grid covering most of the northern hemisphere. We couple the models directly without any flux correction or anomaly maps. For the surface mass balance, we use a positive degree day scheme with lapse rate correction and height desertification effect.

We show results from steady state experiments under last glacial maximum as well as pre-industrial boundary conditions. In both cases, we obtain reasonable ice sheet distributions. In the pre-industrial setup, the Greenland ice sheet looks realistic, and the only major deviation is an ice sheet forming in the Alaska Range due to a cold bias of ECHAM5 in this region. The last glacial maximum ice sheets largely agree with the reconstructions except for an ice sheet that forms in eastern Siberia and connects the Alaskan end of the Laurentide ice sheet to the Fennoscandian ice sheet. The ice sheets never reach a perfectly steady state because parts show repeated surges resembling Heinrich events. We present the ice dynamics during these surges and their consequences in the climate system.